In the Title

Please replace the title as follows:

Method of Production of Polyester Yarn ~~and its Method of Production~~

In the Specification

On page 1, please replace the first paragraph as follows:

~~The present invention~~ This disclosure relates to polyester yarn comprising polytrimethylene terephthalate, and to its method of production. More particularly, it relates to polyester yarn and to a method of producing polyester yarn characterized in that yarn production can be carried out stably at high speeds without package tightening and with little variation in properties in the fibre lengthwise direction and, furthermore, when made into a fabric, there is little sense of tightness because it stretches at a low modulus, and it has a soft handle.

On page 1, please replace the second paragraph as follows:

Background ~~Art~~

Polytrimethylene terephthalate fibre is outstanding in its elastic recovery following elongation, possesses a low Young's modulus and soft bending characteristics and has good dyeing properties and, furthermore, chemically it has stable properties in the same way as polyethylene terephthalate. Hence, as may be seen for example from US Patent Nos 3,584,103 and 3,681,188, it has long been the subject of research as a potential clothing material.

On page 2, please replace the second paragraph as follows:

According to our investigations ~~carried out by the present inventors~~, if the two-stage method generally employed in the case of polyethylene terephthalate fibre is applied as it is to polytrimethylene terephthalate, directly after spinning there commences a change in internal structure and, as a result of a phenomenon referred to as package tightening, differences in properties arise due to differences in the extent of such changes in internal structure between the package inner and outer layers, and so fibre of stable quality is not obtained.

On page 2, please replace the fourth paragraph as follows:

~~Objective of the Invention~~

~~The present invention has as its objective~~ It would therefore be advantageous to provide a polyester yarn which shows no package tightening in the yarn production process so that a package of stable product quality is obtained and, furthermore, which has a low Young's modulus in the elastic recovery region, and is outstanding in its soft stretch properties and softness; together with a method for the production of ~~this~~ such a polyester yarn.

On page 3, please replace the first paragraph as follows:

~~Disclosure of the Invention~~ Summary

~~For the purposes of resolving the aforesaid problem, the~~ The polyester yarn ~~of the present invention has the following constitution. Specifically, the present invention relates to polyester yarn which~~ is characterized in that it is a multifilament yarn substantially comprising polytrimethylene terephthalate, and as well as the strength from the stress-strain curve being at least 3 cN/dtex and the Young's modulus being no more than 25 cN/dtex, the minimum value of the differential Young's modulus at 3-10% extension is no more than 10 cN/dtex and the elastic recovery following 10% elongation is at least 90%.

On page 3 bridging page 4, please replace the third paragraph as follows:

Moreover, woven fabric ~~of the present invention~~ has the following constitution. Specifically, it is a woven fabric which is characterized in that the aforesaid polyester yarn is used as the warp yarn and/or the weft yarn in the form of a twisted yarn of twist coefficient 10,000 to 20,000.

On page 4, please replace the first paragraph as follows:

Brief Description of the Drawings

Figure 1: This is a schematic diagram showing an example of spin-drawing equipment for obtaining

the polyester yarn ~~of the present invention~~.

On page 4, please replace the second paragraph as follows:

Figure 2: This is a schematic diagram showing another example of spin-drawing equipment for obtaining polyester yarn ~~of the present invention~~.

On page 4, please replace the third paragraph as follows:

Figure 3: This shows the stress-strain curve and the differential Young's modulus-strain curve for polyester yarn of ~~the present invention (Example 1)~~ Example 1.

On page 4, please replace the fourth paragraph as follows:

Figure 4: This shows the stress-strain curve and the differential Young's modulus-strain curve for polyester yarn of Comparative Example 4 ~~lying outside the present invention (Comparative Example 4)~~.

On bottom of page 4, please delete the last section title as follows:

~~Best Mode for Carrying out the Invention~~

On page 5, please insert a new section title and replace the first paragraph as follows:

Detailed Description

The polyester yarn ~~of the present invention~~ is multifilament yarn substantially comprising polytrimethylene terephthalate.

On page 5, please replace the second paragraph as follows:

~~In the present invention, the~~ The polyester from which the polyester yarn is composed is polytrimethylene terephthalate (hereinafter abbreviated to PTT) where at least 90 mol% of the structural units are obtained from terephthalic acid as the chief acid component and 1,3-propanediol as the chief glycol component. However, there may be included copolymer components which can form other ester bonds, in a proportion which does not exceed 10 mol% and preferably does not

exceed 6 mol%. Examples of copolymerizable compounds include dicarboxylic acids such as isophthalic acid, succinic acid, cyclohexanedicarboxylic acid, adipic acid, dimer acid, sebacic acid and 5-sodiumsulphoisophthalic acid, and diols such as ethylene glycol, diethylene glycol, dipropylene glycol, butanediol, neopentyl glycol, cyclohexanedimethanol, polyethylene glycol and polypropylene glycol, but there is to be no restriction to these. Moreover, optionally, there may be added titanium dioxide as a delustrant, fine silica or alumina particles as a lubricant, hindered phenol derivatives as an antioxidant, and colouring pigments, or the like.

On page 5, please replace the third paragraph as follows:

It is important that the strength of the polyester yarn ~~of the present invention~~ be at least 3 cN/dtex. If the strength is less than 3 cN/dtex, as well as this leading to fuzzing and yarn breaks in subsequent processing stages such as weaving, the product obtained will also have reduced tear strength.

On page 6, please replace the first paragraph as follows:

Again, it is important that the polyester yarn ~~of the present invention~~ has a Young's modulus of no more than 25 cN/dtex and that it has a minimum value of differential Young's modulus at 3-10% extension of no more than 10 cN/dtex. These properties are closely related to the elongation characteristics and the elastic recovery characteristics in a stretch fabric, and in order to attain the soft stretch property ~~which is the objective of the present invention~~ it is preferred that these properties have low values. That is to say, by satisfying all the above properties, when in the form of a fabric there is easy initial stretch (low Young's modulus) and, furthermore, within the extension range of 3-10%, which is the practical stretch recovery region, elongation is possible with no resistance (low differential Young's modulus). Hence, it is possible to produce a soft stretch fabric which is outstanding in its comfort when worn.

On page 7, please replace the first paragraph as follows:

The polyester yarn ~~of the present invention~~ has an elastic recovery of at least 90% following 10% elongation. If the elastic recovery is less than 90%, then there occurs the problem known as 'sagging' where, following elongation, there remains a portion which has undergone partial plastic deformation, so the woven material quality is reduced. The elastic recovery following 10% elongation is preferably at least 95% and more preferably at least 98%.

On page 7, please replace the third paragraph as follows:

In our experiments ~~by the present inventors~~ it was shown that the higher the degree of crystallinity the higher the elastic recovery. Consequently, the degree of crystallinity is preferably at least 30% and more preferably at least 35%. Here, the measurement of the degree of crystallinity was carried out based on the density in accordance with the density gradient column method of JIS L1013 (Chemical Fibre Filament Yarn Test Methods).

On page 8, please replace the second paragraph as follows:

In the case of the polyester yarn ~~of the present invention~~, it is preferred that the CV% of the yarn lengthwise direction continuous shrinkage factor be no more than 5%. The CV% of the continuous shrinkage factor is an index of the uniformity of internal strain in the yarn lengthwise direction, and the smaller this value the higher the quality. In order to obtain fabric of high quality, the CV% is preferably no more than 5% and more preferably no more than 4%.

On page 8 bridging page 9, please replace the third paragraph as follows:

Again, it is preferred that the CF (coherence factor) value lies in the range 1-30, by subjecting the polyester yarn ~~of the present invention~~ to an interlacing treatment. Where the CF value is at least 1, it is possible to suppress single filament breaks at the time of yarn production and processing, and also at the time of weaving. Furthermore, where the CF value is no more than 30, when for example

performing combination to produce a combined yarn with different shrinkage as one component yarn, migration is facilitated, so this is preferred. It is further preferred that the CF value be 5 to 25.

On page 9, please replace the first paragraph as follows:

The cross-sectional shape of the fibre from which the polyester yarn ~~of the present invention~~ is composed may be of circular cross-section, triangular cross-section, multilobal cross-section, flattened cross-section, X-shaped cross-section or other known profile section, and there are no particular restrictions thereon. Suitable selection may be made in accordance with the objectives.

On page 9, please replace the third paragraph as follows:

In the case of the polyester yarn ~~of the present invention~~, there is a strong correlation between the twist coefficient and the stretch property and, once the twist coefficient exceeds a fixed value, there is a tendency for the stretch property to rapidly increase. In practice, for a woven fabric employing yarn of twist coefficient about 5000, the percentage stretch is about 5%, but with a twist coefficient of 10,000 it is about 15% and with a twist coefficient of 14,000 it is about 30%. Hence, while the polyester yarn obtained ~~in the present invention~~ may be employed without twisting, it is more preferred that it be given a medium to hard twist with a twist coefficient of 10,000 to 20,000.

On page 10, please replace the second paragraph as follows:

The form of the fabric ~~of the present invention~~ may be that of a woven material, knitted material, nonwoven material or cushion material, etc, with suitable selection being made according to the objectives, and the fabric can be used in shirts, blouses, trousers, suits, blousons and the like.

On page 10, please replace the third paragraph as follows:

Next, an example of the method of producing the polyester yarn ~~of the present invention~~ is provided.

On page 10, please replace the fourth paragraph as follows:

As the method for producing the PTT which is the starting material for the polyester yarn ~~of the present invention~~, there can be used a known method as it is. The intrinsic viscosity [η] of the PTT employed needs to be at least 0.7 in order to raise the spinnability at the time of yarn production and in order to obtain yarn of practical strength, but at least 0.8 is preferred.

On page 10 bridging page 11, please replace the fifth paragraph as follows:

Furthermore, in the production of the polyester yarn ~~of the present invention~~, there may be employed continuous polymerization and spinning whereby, following the polymerization, the polymer is directly subjected to spinning and drawing, or alternatively the polymer may first be converted into chip and dried, and then the spinning and drawing carried out.

On page 11, please replace the second paragraph as follows:

What is most important when producing the polyester yarn ~~of the present invention~~ is that there be employed the direct spin-draw method in which the drawing is immediately carried out following spinning, without temporarily winding-up.

On page 11 bridging page 12, please replace the third paragraph as follows:

In undrawn yarn comprising PTT, as stated above, a change in the internal structure begins right after spinning, with the phenomenon referred to as package tightening occurring, and this is a cause of differences in properties arising between the package inner and outer layers. When we ~~the present inventors~~ carried out an investigation to suppress this package tightening, they found that an effective method comprises hauling-off the yarn at a spinning rate of at least 2,000 m/min and then, without temporarily winding up, immediately subjecting the yarn to drawing and heat treatment, after which it is continuously given a relaxation heat treatment by a relaxation factor of 5 to 20%. By using this method, the problem of package tightening is markedly improved, and it is possible to obtain yarn of

high quality in which differences between the package interior and exterior layers are extremely small. Moreover, it has also been discovered that, by subjecting the yarn to a relaxation heat treatment at a high relaxation factor, there is obtained soft stretch yarn which is easily stretched and has a low Young's modulus in the elongation recovery region.

On page 12 bridging page 13, please replace the third paragraph as follows:

It is important that the relaxation factor at the time of the relaxation heat treatment following the drawing be made at least 6 to 20% in order to obtain the polyester yarn ~~which is the objective of the present invention~~. By carrying out a relaxation heat treatment of at least 6% following drawing, it is possible to accelerate the relaxation of internal strain in the fibre, so the level of delayed relaxation of the residual strain is low and package tightening is suppressed. Furthermore, as explained above, by the relaxation heat treatment, elongation is facilitated in the practical extension range (up to 10% extension) and it is possible to confer outstanding characteristics in terms of soft stretch properties. It is further preferred that the relaxation factor be at least 8%. On the other hand, in order to achieve stability of yarn passage in the yarn production process, the relaxation factor is preferably no more than 20% and more preferably no more than 18%.

On page 13, please replace the second paragraph as follows:

Figure 1 is a schematic diagram of the method using a cooling roller in the relaxation heat treatment. Following discharge from spinneret **1**, cooling is carried out in chimney **2**, then convergence and oiling effected at oiling guide **3** and the yarn hauled-off and the temperature raised by first heated roller **4**, after which drawing and heat setting are performed between first heated roller **4** and second heated roller **5**. Furthermore, after passing through the drawing process, by employing the heat of second heated roller **5**, a relaxation heat treatment is carried out between the second heated roller **5** and cooling roller **6**, and winding-up performed by winder **8**. Now, in order to conduct the relaxation

heat treatment still more efficiently, carrying out the relaxation treatment using a heat treatment means employing hot air or steam as a heating medium between the second heated roller **5** and cooling roller **6**, or carrying out the relaxation treatment in two stages by providing a third heated roller, are effective means for ~~realizing the objective of the present invention~~ producing the polyester yarns.

On page 14, please replace the first paragraph as follows:

In each case the relaxation factor is readily controlled and they are methods which are favourably employed in obtaining the polyester yarn ~~of the present invention~~.

On page 16, please replace the second paragraph as follows:

Examples

Below, the ~~present invention~~ disclosure is explained in further detail by means of examples. Now, the various property values in the examples were determined by the following methods.

On page 24, please replace the last paragraph as follows:

Industrial Applicability

With regard to the polyester yarn ~~of the present invention~~ and its method of production, as well as there being no package tightening in the yarn production stage and the package having a stable quality, it is possible to obtain woven fabric of low Young's modulus in the elastic recovery region and which is outstanding in its soft-stretch properties and softness.